Personnel Protection System Upgrade for the Electron Beam Linac For the SLAC Linac Coherent Light Source

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Abstract

As facilities age and evolve, constant effort is needed in upgrading control system infrastructure. This applies to all aspects of an accelerator facility. Portions of the Personnel Protection System of the Linac Coherent Light Source are still relying on a 50 year old relay based Safety System. This presents a substantial risk to the facility's ability to reliably perform its mission. An upgrade is underway to modernize these systems using Siemens S7-300 Safety PLCs and Pilz PNOZMulti programmable controllers. The upgrade will be rolled out over multiple years requiring the implementation to be fully compatible with adjacent legacy system while setting the foundation for the new generation system. The solution is a modularized safety system which can be deployed in a short time (1 month) while being flexible enough to adapt to the evolving needs over the next 20 years. Once fully deployed, the upgraded PPS System will provide not only greater availability to users, but also a higher level of Personnel Safety than previously provided.

Design

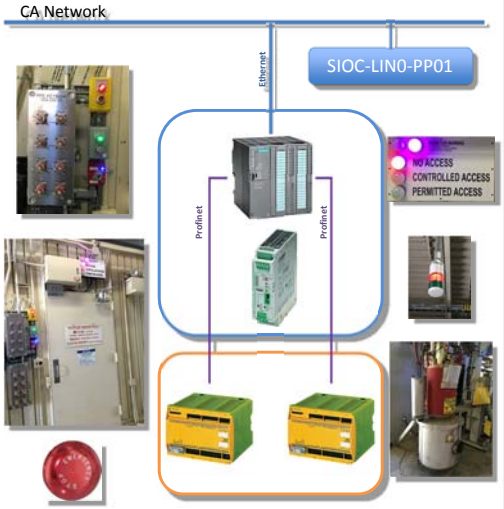
The LCLS Linac is composed of the final 10 sectors (1000m) of the SLAC Linac. The upgraded system divides this into 3 subregions each with a central installation which operates independently. Each sub region is deployed as a standalone upgrade.

1. Linac Sectors 24-25 (Personnel Access Point)
2. Linac Sectors 21-23
3. Linac Sectors 26-30

The new system provides a Personnel Controlled Access through Sector 24 and the flexibility to move between the 3 regions without violating PPS Zone security. This provides a substantial reduction in accelerator downtime following maintenance access.

A key design consideration is installation time. The first two regions had windows of 4 weeks to complete demolition, assembly, and commissioning. This requires a strong focus on staging and a substantial amount of pre-assembly in order to complete.

PLC Architecture



Hardware

- Siemens S7-315F-2PN/DP
- Pilz PNOZMulti Programmable Controllers
- Phoenix Contact QUINT DC Power System
- Fortress Interlocks Key System

Software

- Integrated with SLAC's EPICS based distributed control and data archiving system
- Control functions are gated at the PLC system by a DC hardwire enable sourced only from the ACR (Accelerator Control Room)

Deployment

In order to complete installation in the available time much of the installation was staged or pre-assembled. The rack hardware was assembled and wired on a jig so it could be transported and installed in an existing rack. Overall the project reduced the rack usage from 20 racks down to 6 racks.

New Terminal Cabinets and approx. 4000m of copper trunking was prewired. At install, the legacy system was removed including cable plant, and the conduit was inspected and repurposed. The rack subassembly was installed in the cleared out rack and trunks terminated. New field hardware was installed and terminated at the terminal blocks.

Status and Path forward

The first two regions have been upgraded and are in operation. The final region, Sectors 26 - 30, will be upgraded in 2016. Additionally a similar design model will be used to upgrade the portion of the Linac used for LCLS-II.

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